

# Dairy Industry, 1949

## progress report of research conducted by members of the staff of the Division of Dairy Industry at Davis

The following report was prepared by the staff members of the Division of Dairy Industry under the direction of Professor E. L. Jack, Chairman of the Division of Dairy Industry and Dairy Technologist in the Experiment Station, Davis.

**Bread containing milk** is superior to bread without milk.

An experiment was conducted wherein a group of 320 boys between the ages of eight and 16 were fed breads containing different amounts of non-fat dry milk solids. The non-fat dry milk solids were incorporated in the standard bread in the following amounts: 0%, 6%, 10% and 14% of the quantity of flour. Each of these breads was fed during an eight-week period, after which time the experiment was repeated with a different order of feeding the breads.

The diets were liberal in all respects for which analyses could be made. The daily caloric intake was approximately 2,900 calories, and the daily protein intake exceeded 110 grams. The calcium and phosphorus levels were at or above the recommended amounts.

The daily food consumption ranged from 2,200 to 2,400 grams of which the bread made up 200 to 259 grams.

In both trials the bread consumption increased as the amount of milk in the bread was increased. The following is the average percentage of consumption for the two trials:

Percentage non-fat dry milk solids in bread			
0%	6%	10%	14%
Percentage bread consumption			
100%	104.4%	107.1%	112.6%

A Micro-Mixograph test was developed to determine the baking quality of non-fat dry milk solids when used in bread. Bakers are inclined to reduce the amount of non-fat dry milk solids used in their bread unless they can be sure the milk solids possess high baking quality and will not reduce the volume of the loaf. Each batch of non-fat dry milk solids should be tested by some reliable method before it is offered to the baker.

In the Micro-Mixograph test a dough containing 6% non-fat dry milk solids is made in the Micro-Mixer. A recording device shows the strength of the dough as indicated by the height on the chart and the resistance of the dough to breakdown under continuous mixing. This breakdown shows up as a receding slope on the chart, the measurement of which is called the weakening angle. Doughs containing non-fat dry milk solids of good baking quality will have a large weaken-

ing angle, whereas those of poor baking quality will have a small weakening angle.

The same instrument is being used to test the water absorption property of non-fat dry milk solids when used in bread dough. In this test a dough containing 50% non-fat dry milk solids is used and the absorption value is measured by the dough strength.

### Cottage Cheese

The addition of milk solids to skim milk for the manufacture of cottage cheese improves the nutritive value of the cottage cheese and increases the yield.

Experiments were conducted in which non-fat milk solids both in the form of low-heat dry milk solids and low-heat condensed skim were added to liquid skim milk to increase the solids content to 12%, 15% and 18%. The following shows the recovery of solids in the cheese and the percentage in the curd.

Solids in milk	Recovered	Solids in cheese
9% (no solids added)	32%	21.5%
12%	34%	23.0%
15%	35%	24.5%
18%	37.5%	27.25%

It is necessary to make some changes in the processing procedures to obtain best results when adding non-fat milk solids.

The following table shows the recommended processing procedures:

Per cent solids in milk	Milliliter of Rennet per 1000 lbs. milk	Per cent starter	Setting time in hours
(no solids added)			
9%	1.00	4%	6
(non-fat dry milk solids added)			
12%	1.00	4%	6½
15%	.75	7%	6
18%	.75	12%	6
(condensed skim milk added)			
12%	1.90	5½%	5-5½
15%	2.10	5½%	6
18%	3.00	6%	6

Cottage cheese of excellent quality can be made by these procedures. The addition of non-fat milk solids to liquid skim milk can be used as a method of increasing plant capacity, of centralizing cottage cheese manufacture in one plant by condensing the skim in others and transporting the condensed skim economically, and of increasing the food value of the cottage cheese along with securing increased yields.

### Evaporated Milk

Evaporated milk with improved flavor and color can be produced if the oxygen is removed from the milk before sterilization, and if the sterilization is of the high temperature short-time variety. These facts have been determined by examination of variously processed milks immediately upon processing. Commercial adoption of these processes is retarded by the reversion of flavor and the appearance of gelation and fat separation on storage. Studies are under way to determine the fundamental causes of these defect developments.

### Ice Cream Shrinkage

The tendency of certain ice creams to lose volume on storage or transportation is called shrinkage and has been designated the most important unsolved technical problem in the ice cream industry today. Experiments have contributed in two ways to possible means of combating this defect.

The structural strength of ice cream as indicative of the resistance of the air cell wall to rupture has been determined. An ice cream of standard composition was subjected to progressively lower pressures at constant temperatures, and a similar ice cream to progressively lower temperatures at constant pressures. The pressure and temperature at which the structure became weakened and broke were determined.

Other studies have pointed the way to increasing the resistance of the cell wall to fracture. It has been shown that the state of the milk proteins is a limiting factor in the cell wall strength. Incipient breakdown in the protein structure as measured by the tyrosine value is suffi-

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# Fruit Size and Leaf Composition

## concentration of potassium in orange leaves found to be associated with fruit sizes

E. R. Parker and Winston W. Jones

**Evidence of the effect** of potassium-supplying fertilizers on citrus fruit size in the long-term experimental orchard at Riverside was obtained by determining the concentrations of this and other elements in the leaves.

The concentrations were studied in relation to the sizes of the fruit harvested in 1946 to 1949.

A group of 30 fertilizer treatments was used for this study. A number of the treatments received applications of manure or other bulky organic materials. Others differed in respect to the use of covercrops, phosphate or potash fertilizers, agricultural minerals, sources and amounts of nitrogen.

Composite samples of spring-cycle leaves were harvested in December, 1948, for the analyses. The size of the fruits was highly correlated with the concentration of potassium in the dry weights of the leaves.

The relation of fruit size to potassium concentration was not at first clear. The sizes tended to be larger also when phosphorus was more abundant but smaller when nitrogen or calcium was high. The concentration of each element was found to be affected by the concentrations of the others but the concentrations of potassium were the only ones which were firmly associated with the fruit sizes.

The increases in fruit size due to greater potassium absorption were limited. Maximum fruit sizes in the 1946-1949 crops occurred when the potassium content was about 1.3% in the dry weight

of the December, 1948, leaf samples. In the crops of the individual years, maximum fruit size occurred at leaf concentrations which differed somewhat from this figure.

Large increases in the potassium content of the leaves resulted from the application of bulky organic materials. For example, a treatment which annually received 1.5 pounds of nitrogen per tree from dairy or feed-lot manure produced

fruit of relatively large size. The leaves of the trees which received this fertilizer contained 1.22% of potassium. About three pounds of potash per tree were applied each year in the manure. Supplementing this treatment with applications of sulfate of potash fertilizer did not increase the size of the fruit, although the extra potash considerably increased the potassium in the leaves.

The potassium in the December leaf samples ranged from 0.75% to 1.59% of their dry weights. All of the values are greater than those which have been reported by several investigators to be sufficient to prevent yield reductions and visible deficiency symptoms.

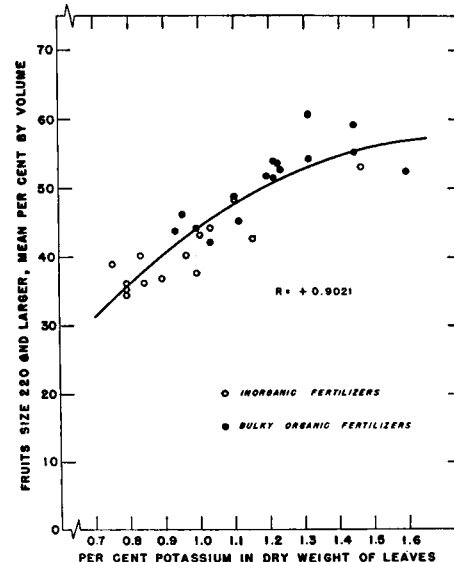
Other factors than potassium supply also influence fruit sizes. In these experiments, this is shown by the fluctuations from year to year in the size of the fruit from trees which have been consistently fertilized with the same materials. In any one year differences in fruit size also occurred when trees were fertilized with the same quantity of potassium.

Inadequate availability of irrigation water is also one factor which reduces the size of oranges. Orchard management practices which affect the penetration of water into the soil may therefore affect fruit sizes.

*E. R. Parker is Horticulturist in the Experiment Station, Riverside.*

*Winston W. Jones is Associate Horticulturist in the Experiment Station, Riverside.*

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Relations between the average size of the fruit—expressed as the percentage of fruits size 220 and larger, by volume—of the crops harvested 1946-1949 and the potassium content of the dry matter of leaves sampled in December, 1948. The data are for trees which have received various fertilizer programs.

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cient change to weaken the cell walls and results in shrinkage under the right conditions. The heat denaturation of the whey proteins and particularly of the globulin fraction is another underlying factor in shrinkage. Addition to a standard mix of less than 0.05% of undenatured globulin markedly reduced the tendency to shrinkage.

### Homogenized Milk

The temperature of milk increases as it is passed through a homogenizer. The Agricultural Code of California specifies

that milk pasteurized by the holding method shall not be heated above 145° F. In order not to exceed this temperature it has been found that the milk should not enter the homogenizer warmer than 137° F if this temperature of 145° F is not to be exceeded, using a homogenizing pressure of 2,000 lbs. per square inch. If higher pressures are used, lower temperatures must be employed.

### Bacteriophage Studies

Dairy plant operators in California suffer from considerable loss at certain times because of the failure of bacterial cultures to coagulate milk satisfactorily for use in making several dairy products.

The findings of the last few months indicate that bacteriophage is of greater importance in California than has previously been suspected in causing slow culture development in dairy products. In nine cases of slow acid production during the past winter, bacteriophage was found to be the cause in each one. Studies of bacteria-bacteriophage relationships and of bacteriophage control are under way.

### Quaternary Ammonium

The action of quaternary ammonium compounds on bacteria is sometimes considered temporary in effect and possible of reversal allowing organisms to grow

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again. Since over three million pounds of these agents are now used annually in sanitizing procedures, it is important to test whether or not they are bacteriocidal—will kill the bacteria—or merely bacteriostatic—preventing increase.

Quaternary compounds, I—alkyl-dimethyl-benzyl ammonium chloride—and II—N-pyridinium chloride—were used on the test organisms *Escherichia coli* and *Micrococcus pyogenes* var. *Aureus*. After use of the quaternary a neutralizing agent, Congo Red, was applied to attempt to reverse the action of the quaternary. Both quaternaries were found to be more active against the *Micrococcus*, a gram positive organism, than against the gram negative coliform organism. Quaternary I was more effective than Quaternary II. Standard plate counts made with inclusion of the neutralizing agent, Congo Red, were slightly higher than where the quaternary alone was used, but when used on dairy equipment the total plate counts were all well within the limits of recommended standards.

### Studies on Rancidity

Milk fat, under certain conditions, is split into its component fatty acids some of which have distinctive flavors and odors. These lipolytic flavors, commonly called rancidity, are a source of much financial loss to the dairy industry through loss or degrading of products. Some of the most troublesome of these flavor defects occur in the winter months and are caused by the lipolytic enzyme that has been designated as naturally active. Studies on the mode of action of this enzyme show that it is present in some milks when the milk is drawn from the cow, and that when that milk is cooled the enzyme is adsorbed on the surface of the fat globule resulting in lipolysis. These studies support the idea that this naturally active enzyme is different from the lipolytic enzyme that is present in all milk which results in rancidity when raw milk is homogenized.

### Solids-Not-Fat and Fat

Over 20,000 samples of milk have been collected from within California and analyzed for solids-not-fat and fat. The samples were from individual patrons collected at the dairy plant over a two-year period and selected so as to be representative of the animals and the type of dairying in the region. The analyses show that the solids-not-fat per cent of milk in California for the state as a whole can be calculated by taking the number 7.62 and adding to it 0.31 times the per cent of fat in the milk. Thus, milk of 3.8% fat

content—which is about the average for the state—will have  $7.62 + (0.31 \times 3.8)$ , equals 8.80% solids-not-fat.

*Some of the studies reported here were supported in part by funds from the California Dairy Industry Advisory Board. The study on Milk-Solids-Not-Fat was supported in part by funds from the California Department of Agriculture, Bureau of Milk Control. The study on Dry Milk in Bread was made possible by the cooperation of the California Youth Authority.*

## CATERPILLAR

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plication of a chemical insecticide. The cost of material plus application cost by airplane in a virus treatment should be less than that of most chemical insecticide applications.

While the successful use of a polyhedrosis as a means of controlling the alfalfa caterpillar may be expected in carefully planned and executed experiments, its general use by the alfalfa growers and commercial applicators of insecticides may entail some difficulties. The timing of application may be so critical that the average grower may not be in a position to determine when the virus

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**CALIFORNIA RICE PRODUCTION**, by Loren Davis, Ext. Cir. 163 April 1950. General discussion of subject amply illustrated and featuring 16 full-page pictures of worst weeds found in California rice fields.

should be used. The most practical solution of the problem appears to be through the use of trained entomologists as is done in supervised control programs.

*Clarence G. Thompson is Junior Insect Pathologist in the Experiment Station, Berkeley.*

*Edward A. Steinhaus is Associate Professor of Insect Pathology and Associate Insect Pathologist in the Experiment Station, Berkeley.*

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